

DOCUMENT RESUME

ED 242 085

EA 016 633

AUTHOR Connors, Eugene T.
TITLE Educational Funding and Pupil Achievement: The Relationship between the Two Variables. Final Report.
SPONS AGENCY Virginia State Dept. of Education, Richmond.
PUB DATE Nov 82
NOTE 55p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Academic Achievement; *Correlation; *Educational Finance; Elementary Secondary Education; Expenditure Per Student; Hypothesis Testing; Predictor Variables; Regression (Statistics); *School District Spending; *Standardized Tests; *Statistical Analysis; Statistical Studies; Tables (Data)

IDENTIFIERS *Virginia

ABSTRACT

To determine whether a significant relationship exists between educational funding and pupil achievement as measured by Science Research Associates standardized test scores, the author of this study conducted a statistical analysis of the top one-third and bottom one-third of Virginia's 142 school districts. The 30 districts selected were chosen according to 3 criteria: school size, relative wealth, and pupil achievement. Spanning the period from 1973-74 through 1981-82, the study gathered pupil achievement data at the 4th, 8th, and 11th grade levels in five subject areas: (1) reading, (2) language arts, (3) mathematics, (4) social studies, and (5) science. To examine the possibility both of a correlation between pupil achievement and educational funding and of a "delay effect" in the impact of educational funding on pupil achievement, the author used a statistical technique known as linear regression. Results of the study indicate variable but significant relationships in all subject areas and at all grade levels between educational funding and pupil achievement; school divisions with higher educational expenditures tend to have higher test scores and vice-versa. The study's appendix contains a copy of the original study proposal as submitted to the Virginia State Department of Education. (JBM)

? Reproductions supplied by EDRS are the best that can be made *
* from the original document. *

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

☒ This document has been reproduced as
received from the person or organization
originating it.

☐ Minor changes have been made to improve
reproduction quality.

• Points of view or opinions stated in this docu-
ment do not necessarily represent official NIE
position or policy.

"PERMISSION TO REPRODUCE THIS
MATERIAL HAS BEEN GRANTED BY

Eugene T.
Connors

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)."

FINAL REPORT

EDUCATIONAL FUNDING

AND

PUPIL ACHIEVEMENT;

THE RELATIONSHIP BETWEEN

THE TWO VARIABLES

.by

Dr. Eugene T. Connors
James Madison University

November
1982

ED242085

EA 016 633

INTRODUCTION

This study attempted to find some significant relationships between educational funding and subsequent educational achievement as measured by SRA standardized test scores. The primary impetus behind this study was the finding of a smaller but similar study conducted in 1981. This earlier study found moderate to high negative correlations (-.45 to .69) between educational funding and pupil achievement. The previous study, however, suffered from two "field-based" shortcomings. There was no statistically acceptable means of selection (the school districts which were used agreed to participate in the study), and there was no attempt to find any "delay-effect" which might occur in such a study. This current study, therefore, is a much more complete and statistically pure follow-up of the previous study.

SELECTION OF SCHOOL DISTRICTS

Since the Commonwealth of Virginia has between 139 and 142 local school districts (the exact number fluctuates from year to year), a sample size of 30 was deemed sufficient to produce statistically significant results. It was also decided to use three criteria in selecting the sample: pupil size, local wealth, and pupil achievement (as measured by the SRA test results). In an attempt to find some type of contribution which these criteria might add to the results, only the top one-third and bottom one-third of each group would be eligible for the selection process. This technique would not, however, exclude any particular school division because, while that division might be excluded from the selection process in one category, it might also be eligible in another category.

The first criteria used for the selection process was pupil size, determined by the average daily membership of each school division as reported in the local school district's Annual Report to the state. The project director elected to use the 1981-82 fiscal year results for these data. The following school districts were randomly selected from the top and bottom one-third of the "pupil size" category:

Largest

Fauquier
Hanover
Spotsylvania
Stafford
Newport News

Smallest

Bland
Craig
Richmond County
Surry
Buena Vista

The second criteria used for the selection process was the relative wealth of the local school divisions. The state's Composite Index is as good an indicator of this criteria as any available, since it is based on three (weighted) economic factors: income of the residents(50%), property tax paid by the residents(40%), and amount of sales tax generated by the locality(10%). Again, it was decided to use the data supplied for the 1981-82 fiscal year for the selection. The following school districts were randomly selected from the top and bottom one-third of the "wealth" category:

Wealthy

Arlington
Middlesex
Charlottesville
Falls Church
Harrisonburg

Poor

Carroll
Grayson
Prince Edward
Scott
Washington

The last criteria to be used in the selection process was "pupil achievement" as measured by SRA test score results. Since SRA results are presented in the form of percentiles which do not have equal intervals, a conversion was first done on all percentile data. These data were converted to "Normal Curve Equivalents" (NCE) which do have equal intervals and, therefore, can be used for statistical analysis. It was decided to use the SRA test results from the 1981-82 academic year for the selection criteria. An average was taken for all subject areas and grade levels tested. Ten school divisions were selected from this category — five from the lower one-third, and five from the upper one-third. The school divisions which were selected were:

High Achievement

Franklin
Mathews
Montgomery
Roanoke County
Poquoson

Low Achievement

Buchanan
Charles City
Isle of Wight
Sussex
Westmoreland

SCOPE OF DATA

The original proposal called for a study to span a ten year period from 1972 to 1982. However, educational achievement data precluded this possibility because 1972 pupil achievement data were reported in "Grade-Level" only, and no conversion table could be located. Therefore, the study includes the academic years 1973-74 through 1981-82.

Educational Data

Pupil achievement data were gathered at three grade levels (when possible): fourth grade, eighth grade, and eleventh grade. Five subject areas were used: reading, language arts, mathematics (total), social studies, and science. As mentioned previously, all percentile data were converted to NCE's. The following formula was used to convert the data:

$$NCE = ((\text{Percentile Score converted to Z-Score}) * (21.06)) + 50$$

Nine means were then calculated. These means would be used in the analysis, not the individual test scores. The means were for the following groups:

Reading mean
Language Arts mean
Mathematics mean
Social Studies mean
Science mean

Fourth Grade mean(all subjects)
Eighth Grade mean(all subjects)
Eleventh Grade mean(all subjects)

Grand mean(all subjects and grade levels)

Finance Data

Financial data were collected from 1968-69 through 1981-82. There were two types of financial data collected. First, the cost of the operation of regular day school was collected from the local school divisions' Annual Report to the state. This figure is reported on page 11 (between lines 17g and 17h). The second type of financial data collected was the ADM figure reported in the Statistical Section of the same annual report (page 14, col. 34, line c). This total cost of education was then divided by the reported total pupil ADM figure, which represents the amount of money spent per pupil(ADM) for that given year.

Since it would be unfair to compare financial figures from several different years because of the effects of inflation, the \$/pupil data had to be converted to some standardized format. Using the Consumer Price Index, all

financial data (\$/pupil) were converted to 1981 United States dollars. The 1981 standard was used since this study was completed before the 1982 year ended, and the CPI could not be exactly determined. The following table reflects the factors used in converting the various years to 1981 dollars:

YEAR I FACTOR		
1969	I	2.614
1970	I	2.481
1971	I	2.342
1972	I	2.246
1973	I	2.174
1974	I	2.047
1975	I	1.844
1976	I	1.690
1977	I	1.598
1978	I	1.500
1979	I	1.394
1980	I	1.253
1981	I	1.104
1982	I	1.000

All data were handled carefully during the recording and computer input process. Checks were made at several steps in this process to insure against typographical errors or incorrect data input.

STATISTICAL PROCEDURES

This study had two primary purposes: First, to

determine if there really is some significant correlation between pupil achievement (as measured by SRA test scores) and educational funding (as measured by funds spent in \$/pupil in ADM); and second, to determine if there is some "delay effect" in the educational funding cycle which may have an impact on pupil achievement. Perhaps the effects of increased funding are not realized, in terms of improved SRA test scores, until several years later.

In order to accomplish both of these purposes, it was decided to utilize a statistical technique known as linear multiple regression. This statistical analysis procedure provides simple correlations between educational funding and pupil achievement, as well as tracing the effects of funding which was analyzed in five steps (from current funding through funding delayed four years). The procedure provides the degree which each year's funding may contribute to the total correlation, as well as a regression formula to predict possible SRA achievement given certain funding patterns.

The SRA test data (converted to NCE's) were used as the dependent variables in the analyses. Five independent variables were regressed against each achievement variable. The five independent variables were: (1) current educational funding, (2) the previous year's educational

funding (This will be referred to as funding delayed by one year, etc.), (3) funding delayed by two years, (4) funding delayed by three years, and (5) funding delayed by four years. All funding data were corrected for inflation by using the Consumer Price Index to convert all figures to 1981 United States dollars, and were in the form of "dollars spent per pupil in average daily membership" (\$/ADM).

HYPOTHESES

The following series of hypotheses were tested in this study as a means of accomplishing the initial objectives set forth in the original proposal.

Null Hypotheses

(1) There will be no significant correlation (at the Alpha = .05 level) between pupil achievement and educational funding.

(2) There will be no "delay-effect" found between educational funding (delayed from zero to four years) and pupil achievement.

(3) No type of prediction formula can be developed to predict future SRA test scores (measured in NCE's).

Alternative Hypotheses

(1) There will be a significant correlation between educational funding and pupil achievement at the .05 Alpha level.

(2) There will be a "delay effect" found between educational funding (delayed from zero to four years) and pupil achievement.

(3) A predictor formula can be developed to predict possible future SRA scores (measured in NCE's) using current and/or past levels of educational funding as input data.

The above hypotheses were conducted eight different times: once on each subject area separately (five), once on each grade level (three), and once on the total mean of the NCE data.

RESULTS

The results of the data analysis were most interesting and illuminating. In each statistical test, the null hypotheses were rejected and the alternative hypotheses were accepted. All results were significant beyond the .05 Alpha level. The following subsections will examine the findings individually.

Reading

The results of the multiple regression on the subject of reading were significant to the .05 Alpha level. The results showed that there is a positive relationship between reading and educational funding. The strength of this relationship when all independent variables are included in the total multiple R is $+ .39$. This multiple R figure, then, can account for 15.39% of the variance in the reading SRA scores (multiple R squared). The following table presents the rest of the statistical results from the multiple regression analysis.

Summary Table of Findings
for
Reading

Dependent Variable = Reading Mean

Independ. Variable	Mult. R	R Diff.	Mult R2	F-Ratio	Sign
Funding (Current)	.2951	—	.0871	23.99	*
Funding(1 yr Delay)	.3327	.0376	.1107	6.51	*
Funding(2yrs Delay)	.3564	.0237	.1227	3.30	*
Funding(3yrs Delay)	.3708	.0144	.1375	4.07	*
Funding(4yrs Delay)	.3923	.0215	.1539	4.51	*

Total Multiple R = .3923

Total Multiple R Squared = .1539

Regression (Predictor) Formula Coefficients

Constant (B0).....	+38.445406
Current Funding (B1).....	-0.007572
1 Year Delay Funding (B2)..	+0.004339
2 Year Delay Funding (B3)..	-0.002245
3 Year Delay Funding (B4)..	+0.002398
4 Year Delay Funding (B5)..	+0.008411

As the above table shows, the multiple R for reading is .3923 which represents over 15% of the variance in the reading scores accounted for as a result of educational funding.

Language Arts

The results of the analysis on the Language Arts variable are very similar to the Reading results. There is a positive correlation between Language Arts and educational funding to the order of +.40 . The following table represents the rest of the results of the analysis.

Summary Table of Findings for Language Arts

Dependent Variable = Language Arts Mean

Independ. Variable	Mult. R	R Diff.	Mult R2	F-Ratio	Sign
Funding (Current)	.3628	—	.1316	31.86	*
Funding(1 yr Delay)	.3712	.0084	.1378	1.51	
Funding(2yrs Delay)	.3735	.0023	.1395	0.42	
Funding(3yrs Delay)	.3868	.0133	.1496	2.44	*
Funding(4yrs Delay)	.4020	.0152	.1616	2.89	*

Total Multiple R = .4020

Total Multiple R Squared = .1616

Regression (Predictor) Formula Coefficients

Constant (B0)..... +37.826754
 Current Funding (B1)..... -0.001577
 1 Year Delay Funding (B2).. +0.003077
 2 Year Delay Funding (B3).. -0.004617
 3 Year Delay Funding (B4).. +0.001812
 4 Year Delay Funding (B5).. +0.006085

Mathematics

Of all the subject areas tested, the subject of Mathematics possessed the highest correlation to educational funding. The total multiple R for Mathematics was +.50 . This is a high level of correlation given the past beliefs that funding had little-or-nothing to do with educational attainment. The other relevant statistics are presented below:

Summary Table of Findings for Mathematics

Dependent Variable = Mathematics Mean

Independ. Variable	Mult. R	R Diff.	Mult R2	F-Ratio	Sign
Funding (Current)	.3972	—	.1578	48.40	*
Funding(1 yr Delay)	.4362	.0690	.1903	9.98	*
Funding(2yrs Delay)	.4452	.0090	.1982	2.40	*
Funding(3yrs Delay)	.4770	.0318	.2275	8.99	*
Funding(4yrs Delay)	.4968	.0198	.2468	5.93	*

Total Multiple R = .4968

Total Multiple R Squared = .2468

Regression (Predictor) Formula Coefficients

Constant (B0).....	+36.407416
Current Funding (B1).....	-0.007859
1 Year Delay Funding (B2)..	+0.007310
2 Year Delay Funding (B3)..	-0.007001
3 Year Delay Funding (B4)..	+0.005323
4 Year Delay Funding (B5)..	+0.008602

Social Studies

The results of the Social Studies analysis were quite interesting. Next to Mathematics, Social Studies possessed the highest correlation to educational funding. The correlation was +.48 with a multiple R squared of +.23. The rest of the results are presented below:

Summary Table of Findings for Social Studies

Dependent Variable = Social Studies Mean

Independ. Variable	Mult. R	R Diff.	Mult R2	F-Ratio	Sign
Funding (Current)	.4053	—	.1643	49.75	*
Funding(1 yr Delay)	.4402	.0349	.1938	8.92	*
Funding(2yrs Delay)	.4490	.0088	.2016	2.35	*
Funding(3yrs Delay)	.4678	.0188	.2188	5.22	*
Funding(4yrs Delay)	.4833	.0155	.2336	4.49	*

Total Multiple R = .4833

Total Multiple R Squared = .2336

Regression (Predictor) Formula Coefficients

Constant (B0)..... +36.592532
 Current Funding (B1)..... -0.006406
 1 Year Delay Funding (B2).. +0.006000
 2 Year Delay Funding (B3).. -0.003724
 3 Year Delay Funding (B4).. +0.002969
 4 Year Delay Funding (B5).. +0.006849

Summary Table of Findings for Science

Independ. Variable	Mult. R	R Diff.	Mult R2	F-Ratio	Sign
Funding (Current)	.3027	—	.0916	25.26	*
Funding(1 yr Delay)	.3499	.0472	.1224	8.50	*
Funding(2yrs Delay)	.3531	.0032	.1247	0.62	
Funding(3yrs Delay)	.3752	.0221	.1408	4.46	*
Funding(4yrs Delay)	.3982	.0230	.1586	4.91	*

Constant (B0).....	+39.400482
Current Funding (B1).....	-0.007733
1 Year Delay Funding (B2)..<	+0.008528
2 Year Delay Funding (B3)..<	-0.005949
3 Year Delay Funding (B4)..<	+0.002158
4 Year Delay Funding (B5)..<	+0.007468

GRADE LEVEL FINDINGS

The following sections examine the results of the multiple regression analysis in terms of educational funding's impact on grade level SRA scores. Since the Commonwealth of Virginia only requires that such SRA testing be done at the fourth, eighth, and eleventh grade levels, only these three grades will be analyzed.

Fourth Grade Results

Of all the grade level regressions, the fourth grade level results are the highest. This is to be expected. Since correlation is, to a certain degree, a product of variance, the relative compactness of the educational scores in the fourth grade (as compared with subsequent grades) accounts for the higher correlation. The total multiple R of the fourth grade analysis was +.44 with a multiple R squared of +.19. The following table presents the other statistics:

Summary Table of Findings
for
Fourth Grade

Dependent Variable = Fourth Grade Mean

Independ. Variable	Mult. R	R Diff.	Mult R2	F-Ratio	Sign
Funding (Current)	.3321	—	.1103	35.70	*
Funding(1 yr Delay)	.3375	.0054	.1139	1.16	
Funding(2yrs Delay)	.3800	.0425	.1444	9.88	*
Funding(3yrs Delay)	.4231	.0431	.1790	11.19	*
Funding(4yrs Delay)	.4401	.0170	.1937	4.76	*

Total Multiple R = .4401

Total Multiple R Squared = .1937

Regression (Predictor) Formula Coefficients

Constant (B0)..... +41.671831
 Current Funding (B1)..... -0.001517
 1 Year Delay Funding (B2).. -0.005150
 2 Year Delay Funding (B3).. +0.000191
 3 Year Delay Funding (B4).. +0.005192
 4 Year Delay Funding (B5).. +0.006733

Eighth Grade Results

As expected, the eighth grade level results were slightly lower than the fourth grade results. The eighth grade multiple R was +.40 . The other results of the data analysis are presented below:

Summary Table of Findings for Eighth Grade

Dependent Variable = Eighth Grade Mean

I Independ. Variable	I Mult. R	I R Diff.	I Mult R2	I F-Ratio	I Sign
I Funding (Current)	I .3531	I —	I .1247	I 34.46	I *
I Funding(1 yr Delay)	I .3696	I .0165	I .1366	I 3.30	I *
I Funding(2yrs Delay)	I .3703	I .0007	I .1371	I 0.12	I
I Funding(3yrs Delay)	I .3878	I .0175	I .1504	I 3.67	I *
I Funding(4yrs Delay)	I .4005	I .0127	I .1604	I 2.76	I *

Total Multiple R = .4005

Total Multiple R Squared = .1604

Regression (Predictor) Formula Coefficients

Constant (B0)..... +34.759021
 Current Funding (B1)..... -0.004282
 1 Year Delay Funding (B2).. +0.007114
 2 Year Delay Funding (B3).. -0.006217
 3 Year Delay Funding (B4).. +0.002616
 4 Year Delay Funding (B5).. +0.006604

Eleventh Grade Results

The eleventh grade level results were the lowest of the three grade levels analyzed. But, as mentioned previously, this is to be expected. The greater variance of the data may, alone, account for the lower correlations.

The correlation between eleventh grade SRA scores and educational funding was $+0.40$ with a multiple R squared of $.1562$. The charts presented below provide the other data results from this analysis:

Summary Table of Findings for Eleventh Grade

Dependent Variable = Eleventh Grade Mean

Independ. Variable	Mult. R	R Diff.	Mult R2	F-Ratio	Sign
Funding (Current)	.3291	—	.1083	26.18	*
Funding(1 yr Delay)	.3718	.0427	.1382	7.22	*
Funding(2yrs Delay)	.3740	.0012	.1399	0.42	
Funding(3yrs Delay)	.3859	.0119	.1489	2.17	
Funding(4yrs Delay)	.3952	.0093	.1562	1.77	

Total Multiple R = .3952

Total Multiple R Squared = .1562

Regression (Predictor) Formula Coefficients

Constant (B0).....	+34.627760
Current Funding (B1).....	-0.008245
1 Year Delay Funding (B2)...	+0.009766
2 Year Delay Funding (B3)...	-0.004491
3 Year Delay Funding (B4)...	+0.002743
4 Year Delay Funding (B5)...	+0.005469

.....

Summary Table of Findings for Total Scores

Independent Variable	Mult. R	R Diff.	Mult R2	F-Ratio	Sign
Funding (Current)	.3720	—	.1384	33.96	*
Funding(1 yr Delay)	.3906	.0186	.1526	3.50	*
Funding(2yrs Delay)	.3912	.0006	.1560	0.82	
Funding(3yrs Delay)	.4084	.0172	.1668	2.65	*
Funding(4yrs Delay)	.4254	.0170	.1810	3.49	*

Total Multiple R = .4254
Total Multiple R Squared = .1810

Regression (Predictor) Formula Coefficients

Constant (B0).....	+37.002532
Current Funding (B1).....	-0.004226
1 Year Delay Funding (B2)..	+0.005082
2 Year Delay Funding (B3)..	-0.004321
3 Year Delay Funding (B4)..	+0.001763
4 Year Delay Funding (B5)..	+0.007168

CONCLUSION

There are many conclusions which can be drawn from the results presented above. However, there is one observation which must be stated — it is clear that, to a degree, pupil performance on standardized tests (such as the SRA achievement tests) is related to the level of educational expenditure! It is vital that people understand one very important consideration of multiple regression/correlation analysis — correlation does not necessarily suggest cause and effect.

With the above in mind, certain specific conclusions can be generalized based upon the degree of significance of the results, as well as the degrees involved in the multiple correlations. These specific results are as follows:

(1) There is a significant correlation between reading and educational funding. However, the degree of correlation is not as high as in other subject areas. The multiple correlation of $+0.39$ suggests that approximately 15% of the variance in reading scores among school divisions is a function of the levels of educational funding.

(2) The subject of Language Arts is closely aligned to reading. Therefore, it is not surprising that the results of the multiple regression analysis are quite similar to the Reading results. There is a significant correlation between Language Arts and educational funding. The level of this correlation is $+ .40$.

(3) The subject of Mathematics showed the highest correlation to educational funding than any other area involved in the study. A multiple correlation of $+ .50$ suggests a strong relationship between how well pupils do on mathematics standardized tests and the levels of educational funding.

(4) Social Studies also showed a strong relationship between educational funding and the SRA test scores. A significant correlation of $+ .48$ illustrates this relationship.

(5) The subject area of Science possessed a moderate relationship to educational funding with a correlation of $+ .40$. This relationship, like all the others, was significant.

(6) As expected, the fourth grade correlation with educational expenditures was quite high. The correlation

was $+0.44$, which accounts for almost 20% of the variance in the fourth grade scores. This category of analysis used the mean from all five subject areas tested. The results from this analysis suggest that fourth grade achievement on SRA standardized tests is significantly related to the amount of funds spent on education.

(7) The eighth grade correlation was slightly less than the fourth grade figure. A multiple R of $+0.40$, however, is still quite high in spite of the fact that there is much more variance in the test scores of eighth graders than there is of fourth graders. This degree of correlation tends to support the conclusion that intermediate school achievement is also related to funding.

(8) The multiple correlation of eleventh grade SRA test data with educational funding was almost identical to the eighth grade results. A significant R value of $+0.40$ demonstrates that even high school achievement is related to the level of educational funding.

(9) The level of correlation of the total mean was quite surprising. The total mean examines SRA achievement test data from all five subject areas in all three grades. The correlation produced by the multiple regression was $+0.43$, which is quite high for this type of study. Indeed, the

multiple R squared of .18 indicates that over 18% of the variance of test scores among school divisions can be accounted for through the differing levels of educational funding.

The results of this study are quite important to public education in Virginia. This study has amply demonstrated that there is a significant relationship between educational funding and pupil achievement as measured by SRA achievement tests. School divisions who spend more on education tend to have higher test scores and vice-versa.

APPENDIX A

The following section contains a copy of the original proposal for this study which the Virginia State Department of Education, Pilot Study Division funded.

ABSTRACT

This study seeks to examine the relationship between educational funding and pupil achievement. While similar studies which were conducted in the early 1970's found no relationship between educational cost and educational quality, two more recent studies indicate that a trend connecting the two variables may be developing. In particular, Connors' 1981 study correlating pupil achievement and educational funding among ten school divisions in Virginia found negative meaningful correlations (from $-.33$ to $-.70$).

This study hopes to either verify or refute the 1981 report. By using a much more sophisticated and statistically sound system of sampling, this project will examine the complex relationship between funding of education and its subsequent impact on pupil achievement. This project will also determine if there is a "delay - effect" operating in this relationship. While there may not be any significant (and meaningful) relationship

between the cost and quality variables for a given year, it is quite possible that the funding of education may have a significant impact on pupil achievement several years later. This possibility will be examined through the use of the linear multiple regression procedure where two measures of educational funding (cost per pupil and percent change in cost per pupil) will act as independent variables and measures of pupil achievement (SRA achievement test score results in five subject areas at three grade levels) will serve as the dependent variable. The funding variables will be regressed in five ways: comparing year to year, and then delaying the achievement one year at a time for up to four years in order to reveal any delay in which cost may affect quality.

The results of this study will aid both educators and public officials in understanding the complex and elusive relationship between cost of education and its subsequent impact on measurable quality of the educational system. Also, this is the first known study to examine the "delay - effect" in the area of cost/quality relationships.

EDUCATIONAL FUNDING
AND
PUPIL ACHIEVEMENT:
IS THERE A
STATISTICALLY SIGNIFICANT
RELATIONSHIP BETWEEN
THE TWO VARIABLES?

by

Dr. Eugene T. Connors
James Madison University

1982

INTRODUCTION

The last four or five years of the 1970's and the first two years of the 1980's have caused serious concern on the part of the public regarding the spending by government units. Indeed, the results of the 1980 presidential election have confirmed that the average U. S. citizen wants government accountability. While "Reagan-omics" has been set forth as the panacea of the federal problem, there has been no such single solution to state and local funding excesses.

Of all state and local government expenditures, public education demands the largest percentage. This propensity towards spending large amounts of public funds on the educational process was recognized as early as 1959 by the Illinois Supreme Court in the infamous "Molitor v. Kaneland Community School District" (18 Ill. 2d 11, 163 N.E. 2d 89) decision where the court labeled public education as "...one of the biggest business in the country..."

Various studies have confirmed the fact that since 1970, education outspent inflation by somewhere near 25-30 percent. A recent study conducted in Virginia sets this figure at slightly over 31 percent. However, in spite of this high propensity to spend funds on public education,

two contrasting results have emerged. First, there is a growing public concern about the quality of public education given the large sums of money being spent. The public hears almost daily about the failures of America's public schools to teach even the most rudimentary of sociological survival skills. Newspapers and the media are constantly bombarding the public with stories about declining standardized test scores (namely the SAT and SRA achievement tests). And second, professional educators claim that they do not have the proper resources to improve the quality of education. Such resources require additional funds which the public is unwilling to appropriate given the past performance of the educational system.

Hence, the problem: The public is unwilling to spend additional funds on education because it feels that education is not delivering its product (an educated pupil) as promised. Educators claim, on the other hand, that they need more funds in order to do a better job at educating the youth of today. But in spite of these counter-claims made by both sides of the issue, there has never been the attempt to find the exact relationship between educational funding and pupil achievement as measured by standardized test scores.

THE PROBLEM

Is there a statistically significant relationship between educational funding and pupil achievement as measured by the state mandated SRA test scores in elementary, intermediate, and high school levels?

Is there a delay between the funding of education and its subsequent effect on pupil achievement?

If there is a significant relationship between funding and pupil achievement, and if there is a delay between funding and its affect on educational quality, can a predictor formula be constructed through the statistical procedure known as Linear Multiple Regression?

REVIEW OF RELATED LITERATURE

There is a conspicuous lack of literature regarding the relationship between educational funding and pupil achievement. Most of the studies which did attempt to draw this comparison evolved out of Title I funds in the early 1970's and usually dealt with only a single measure of pupil achievement.

Two studies illustrate the results of the early 1970's studies. In 1972, two researchers working on completely

separate studies reached the same conclusions regarding relationships between educational funding and pupil achievement. Kaster G. Tallmadge analyzed Mathematics and Reading achievement in terms of educational funding and found no significant correlations (as well as correlations very close to zero). Similarly, Joan M. Webster found no relationship between reading achievement and funding of education in six Grand Rapids schools.

In 1978, Dennis C. Carey conducted a study examining the relationship between I.Q. test scores, community status, and educational funding. The regression analysis revealed that there was no significant relationship between funding and student achievement.

D. A. Dawson conducted a very extensive and interesting study for the Ontario Public School System in Canada in 1978. The study revealed a very weak connection between cost and quality of education. However, this study did find meaningful correlations in various unconnected areas. The author concluded the results by stating that there was not a very "well defined relationship between cost and quality of education".

If a trend exists in this area, the following study has certainly advanced the status of cost/quality research projects. In 1981, Connors conducted an abbreviated study for the Virginia State Department of Education, Pilot Studies Division. This study was conducted at the request

of several local school division superintendents who sought to use the (presupposed) results to ask for additional local funding of education. The study's results were quite unexpected and unfavorable to education. First, the study showed that all of the ten participating school divisions outspent inflation by an average of 31 percent between the years 1970 and 1980. The study also revealed some very disturbing results concerning funding and educational achievement. On the average, there was a negative correlation between the level of educational funding and pupil achievement as measured by SRA standardized achievement tests. In short, the degree of correlations by subject area looked thus:

Reading (Fourth Grade).....	-.6893
Mathematics (Fourth Grade).....	-.6929
Science (Fourth Grade).....	-.6969
Social Studies (Fourth Grade).....	-.6885
Language Arts (Fourth Grade).....	-.6837
Reading (Eighth Grade).....	-.5770
Mathematics (Eighth Grade).....	-.6395
Science (Eighth Grade).....	-.5628
Social Studies (Eighth Grade).....	-.5790
Language Arts (Eighth Grade).....	-.6098
Reading (Eleventh Grade).....	-.3334
Mathematics (Eleventh Grade).....	-.4160
Science (Eleventh Grade).....	-.3443
Social Studies (Eleventh Grade)...	-.4659
Language Arts (Eleventh Grade)....	-.3279

All the above results were found to be significant at the .05 alpha level. While the findings of the 1981 Connors' report suggest that additional funding of education may

actually be detrimental to learning, there are two glaring problems with the study. First, the study did not follow any accepted method of statistical sampling. The ten school divisions were selected because they agreed to participate in the study. There is no way of knowing whether or not these ten school divisions actually reflect the true situation in the Commonwealth of Virginia! And second, there was no attempt to analyze a "delay effect". Such an effect could account for the above results in suggesting that the effects of increased educational funding might not be felt for several years when using standardized test scores as the variable representing pupil achievement.

JUSTIFICATION

The 1981 Connors' study raises some interesting questions: First, is there really a negative relationship between funding and pupil achievement? Are the results of that study applicable to all school divisions in Virginia? And how can one account for the "delay-benefit" argument that funding may not affect pupil performance for several years after the funds are spent?

A new, broader, and more complex study is needed to

answer these and other questions. If there really is a negative correlation between funding and pupil achievement, then a local school board might want to examine how the funds are being spent. On the other hand, a statistically proper sampling of school divisions might refute the 1981 study and show that funding does (positively) affect pupil performance. Such a new study can also examine the "delay" contention which several educators have proposed.

It would not be in the best interest of public education to allow the 1981 study to go unchallenged with its devastating results. A larger, more experimentally designed project should be conducted to either confirm or refute the previous study's results.

Dr. Gerald Bracy, Director of Virginia State Department of Education's Division of Research, Evaluation, and Testing, has suggested that the results might represent a statistical artifact — results which occur in spite of proper use of statistics, but which do not accurately represent the actual population.

DEFINITION OF TERMS

ADM : Average Daily Membership; the pupil accounting method use in Virginia.

Academic Achievement : Level of academic progress; measured by SRA tests in five subject areas when pupils reach fourth, eighth, and the eleventh grades.

Delay - Benefit : The concept that funding may not have an immediate impact on pupil academic achievement but may be delayed from one to four years.

Funding : Measured in "Per Pupil Costs" (or "Costs per Pupil"). All funding will be corrected for inflation and will be reported in 1982 dollars.

Grade Average : NCE Scores for the five SRA subjects averaged together to provide an overall achievement level by grade.

High Academic Achievers : Those school districts who are in the upper third of the state's SRA test scores (all scores and grades averaged together) measured in 1982.

Large School Districts : Those school districts who are in the upper third of the districts in Virginia in terms of the size of pupil enrollment.

Low Academic Achievers : Those school districts who are in the lower third of the state's SRA test scores.

NCE's : Normal Curve Equivalents; A means of measuring pupil achievement that can be statistically analyzed. All SRA test score results will be converted to NCE's before data analysis begins.

Non-Wealthy School Districts : Those school districts who are in the lower third of the state's school districts in terms of relative wealth. This element is measured by the state's composite index.

Percent Change : The percent change in funding from any given year when measured against the first year studied. It is a measure of propensity to spend funds on education.

Per Pupil Costs : A measure of educational funding. Arrived at by dividing the amount of funds spent on the regular day program by the total number of pupils in ADM.

Sample : Thirty school districts in Virginia.

Small School Division : Those school divisions who are in the lower third of school districts in terms of size.

Statistically Meaningful : Correlations greater than .40 or less than -.40.

Statistically Significant : Where data analysis reveals significance at the .05 level or less.

Total Average : When all of a school divisions' SRA scores are averaged together (4th, 8th, and 11th grade scores).

Total Population : All of the school divisions in the Commonwealth of Virginia.

OBJECTIVES

There are three major objectives of this proposed study. They are as follows:

- (1) To determine if there is any significant relationship between the funding of public education and pupil achievement as measured by standardized test scores.
- (2) To determine if such a relationship might not be "delayed" in its impact by anywhere from one to four years.
- (3) If there is a significant relationship between funding and pupil achievement, and if such a relationship might involve the "delay" aspects

(mentioned in Objective Number Two), then develop predictor formula through the statistical procedure known as multiple linear regression.

HYPOTHESES

The following are the hypotheses of this study. These hypotheses coincide with the above stated objectives:

Null Hypotheses

- (1) There will be no statistically significant or meaningful correlations between pupil achievement and educational funding.

This hypothesis will be tested in four ways:

- (A) The test will be run on the total population.
 - (B) The test will be run on school divisions which are in the top and bottom one-third of the population in terms of pupil achievement.
 - (C) The test will be run on school divisions which are in the top and bottom one-third of the population in terms of wealth (as measured by the state's composite index).
 - (D) The test will be run on school divisions which are in the top and bottom one-third of the population in terms of pupil size.
- (2) There will be no "delay - effect" between pupil achievement and educational funding when such funding is delayed:

- (A) by one year.
- (B) by two years.
- (C) by three years.
- (D) by four years.

- (3) If the null hypotheses presented above (in number 1 and 2) are rejected, then the development of a predictor formula by means of linear multiple regression will not be possible.

Alternative Hypotheses

- (1) There will be a statistically significant and meaningful correlation between pupil achievement and educational funding.

This alternative hypotheses consists of four subgroups:

- (A) A test run on the total statistical sample.
- (B) A test run on the upper and lower one-third of the population in terms of pupil achievement.
- (C) A test run on the upper and lower one-third of the population in terms of wealth.
- (D) A test run on the upper and lower one-third of the population in terms of pupil size.

- (2) There will be a "delay - effect" experienced in at least one of the following categories:

- (A) a one year delay.
- (B) a two year delay.
- (C) a three year delay.
- (D) a four year delay.

- (3) (If the null hypotheses of 1 and 2 above are rejected and their appropriate alternative hypotheses accepted, then) a predictor formula will be constructed through the use of a linear multiple regression statistical procedure.

DELIMITATIONS

This study will not be concerned with the following:

- (1) School districts located outside the Commonwealth of Virginia.
- (2) Any school district that was not in existence between 1968 and 1982.
- (3) The school district which serves as the fiscal agent for this study.
- (4) Any measures of pupil achievement other than the state mandated SRA tests in Reading, Science, Mathematics, Social Studies, and Language Arts.
- (5) Any measure of educational funding other than the cost of "Regular Day School Operation" (between lines 17g and 17h on the Annual Report to the state) which will be divided by "Total Number of Pupils in ADM" (reported in the statistics section of the Annual Report).

ASSUMPTIONS

The following are some assumptions on which this study will be based:

- (1) Pupil achievement can be accurately measured by the SRA standardized tests in Reading, Science, Mathematics, Social Studies, and Language Arts.
- (2) The above mentioned SRA measures accurately reflect learning as it is being taught in the public schools.
- (3) That the method used in selection will produce a sample that accurately reflects the total school district population as a whole.

STATISTICAL METHODOLOGY

The following sections will discuss the various

methods which are to be employed in this study. At all times, only acceptable methods of selection, acquisition of data, data manipulation, and use of statistical procedures will be employed.

Sampling Process

The nature of this project and the results of previous studies show three criteria that need to be considered when selecting the data base. These criteria are (1) the relative degrees of pupil achievement as measured by 1982 SRA test scores; (2) the relative degrees of wealth as measured by the state's composite index (1981/82); and (3) the relative degrees of pupil size as measured by total number of pupils in ADM as reported by the State Superintendent's most recent memo (probably Spring, 1982).

In order to compensate for these three criteria, a stratified random sample will be used. The total "N" of the sample will be 30. This figure was arrived at by examining the amount of work involved in gathering data for a larger number (and found to be excessive), the accuracy with which this sample size can reflect the total population (141 school districts), and the fact that an N of 30 moves the study out of the small sample penalties

utilized by various statistical procedures.

Of the total N, ten will be selected from the "wealth" category, ten will be selected from the "size" category, and ten will be selected from the "achievement" category. Using the state's composite index as an indicator of wealth, five school divisions will be selected from the top one-third (very wealthy) and five will be selected from the lower one-third (not wealthy). The same process will be used to select the school districts in the size category: five will be selected from the top one-third (large) and five will be selected from the lower one-third (small). Similarly, five school divisions will be selected from the top one-third in terms of pupil achievement and five will be selected from the lower one-third (as measured by 1982 SRA tests using an average of the five subject areas). All final sampling will be done through a random process. No school division can be selected twice (through use of the different categories). It is important to point out that this selection method does not exclude "normal" or "average" school districts. It is quite possible that a school district that may fall in the upper or lower one-third of one category could be in the middle one-third of the other two categories. Therefore, this stratified random sampling technique does not discriminate against the normal school division.

Data Acquisition

All data which will be utilized in this study is public domain. Therefore, permission is not needed to acquire it. The financial data will consist of two variables: "Regular Cost of Day School" and "Total Pupils in ADM." Both of these data sets are available in the Annual Reports made to the State Department each year by every school division. The "Regular Cost of Day School" is found between lines 17g and 17h of the Annual Report. These data will be gathered for each school division in the sample for the years 1968 through 1982. The "Total Students in ADM" is also available in the statistics section of the annual report and will also be gathered from 1968 through 1982.

The pupil achievement data will be gathered through the Testing Division of the Virginia State Department of Education. Dr. Claude Sandy, Associate Director, will provide these data for this project. The SRA scores will be collected for the years 1972 through 1982. These scores are available in five subject areas (Reading, Science, Mathematics, Social Studies, and Language Arts) for three grade levels (fourth, eighth, and the eleventh grade). Once again, these scores are public domain and permission is not needed to obtain them.

The reason that the financial data is being gathered for 1968-82 and the pupil achievement data is being gathered for 1972-82 is two-fold: First, the state did not begin utilizing SRA scores until 1972. Prior to that time, the STEP-SCAT series was used. The two series of tests are not compatible for statistical analysis and, therefore, there can be no overlap from one data source to another. And second, since a "delay - effect" is being examined, it is necessary to acquire financial data for four years farther back in time than achievement data. The time period of four years was determined because pupils in the Commonwealth of Virginia take the SRA series every four years (fourth, eighth, and eleventh grade) and any delay effect longer than that period of time would be visible in the next (older) class taking the tests.

Data Manipulation

There will not be a need for much data manipulation in this study due to the relative straight forwardness of the originally collected data. The financial data will require three simple procedures to put it in the proper form for statistical analysis. The first procedure will be to divide "Total Cost of Regular Day Program" by that same

year's "Total Pupils in ADM" to produce a variable which this study will call "Cost per Pupil". This calculation will be done for every school division selected as well as for every year from 1968 through 1982. The second procedure will be to correct each year's "Cost per Pupil" for inflation by multiplying that variable by the appropriate year's inflation index. All money figures presented in the study will be in 1982 U.S. dollars. The third procedure will be to examine each school division's propensity to spend money on education by calculating the percent increase (or decrease) each year from the base year (1968, 1969, 1970, 1971, and 1972 depending on the level of the "delay - effect"). In his 1981 study, Connors found that no school division actually decreased its per pupil cost after inflation was taken into account. Therefore, it is highly unlikely that a decrease will be found in the calculation of the "Percent Change" variable.

The pupil achievement data will undergo only two procedures before it is ready for statistical manipulation. The first step, however, is a vitally important one. All pupil achievement data are reported in "Percentiles". Unfortunately, percentiles do not possess identical intervals and, therefore, are unsuitable for statistical analysis. However, these percentiles can be converted to "Normal Curve Equivalents" (NCE) which do possess equal intervals and can be analyzed through statistical

procedures. This conversion is done by first changing the percentiles to Z-Scores which are then converted to NCE's using the following formula:

$$NCE = (Z * 21.06) + 50$$

The second procedure is to find several averages for the school division's data. All fourth grade scores will be averaged together to find a fourth grade mean. An identical process will be done to the eighth grade scores, the eleventh grade scores, and the total school division's scores. By creating such means, analysis can be performed on a school divisions' total scores, and scores by grade as in addition to the individual subject scores.

Statistical Procedures

Since the statistical procedure known as linear multiple regression also utilizes correlations which are calculated among the various variables, the use of this single procedure can adequately satisfy the statistical requirements of the three null hypotheses presented earlier. All finance variables will be regressed against each pupil achievement variable. The finance variables will be used in four groups:

- (1) Cost per Pupil
 - (A) Each year vs. achievement data's same year.
 - (B) One Year Delay.
 - (C) Two Year Delay.
 - (D) Three Year Delay.
 - (E) Four Year Delay.
- (2) Percent Change from Base Year
 - (A) Each year vs. achievement data's same year.
 - (B) One Year Delay.
 - (C) Two Year Delay.
 - (D) Three Year Delay.
 - (E) Four Year Delay.

These regressions will be performed on each pupil
achievement variable listed below:

- (A) 4th Grade Reading
- (B) 4th Grade Science
- (C) 4th Grade Social Studies
- (D) 4th Grade Mathematics
- (E) 4th Grade Language Arts
- (F) 4th Grade Average
- (G) 8th Grade Reading
- (H) 8th Grade Science
- (I) 8th Grade Social Studies
- (J) 8th Grade Mathematics
- (K) 8th Grade Language Arts
- (L) 8th Grade Average
- (M) 11th Grade Reading
- (N) 11th Grade Science
- (O) 11th Grade Social Studies
- (P) 11th Grade Mathematics
- (Q) 11th Grade Language Arts
- (R) 11th Grade Average
- (S) Total Average (4th, 8th, and 11th Grade Scores)

PERSONNEL, FACILITIES, AND TIME

There will be no need for any of the school districts that will be selected for this study to commit any personnel, facilities, or time. The commitments of the school divisions acting as fiscal agent will also be minimal. Dr. Eugene T. Connors, Associate Professor of Education at James Madison University, will serve as project director and will act as the principal consultant for this project. Dr. Connors will be responsible for collecting the data, applying the appropriate statistical procedure, analyzing the results, and writing the final report. Dr. Connors will employ a number of graduate and undergraduate assistants to help in these matters. However, the involvement of these student assistants will be on a subcontract basis only.

There will be no need to utilize any of the facilities of the sponsoring school division or the State Department of Education in any way. Use of computer time, xeroxing, secretarial help, et cetera, will be the responsibility of the project director.

Understanding that "Murphy's Law" must be contended with ("Everything takes longer than it is expected to!"), this project should be completed in early fall. The current target date is October 1, 1982. However, this target completion date depends upon two primary factors: first, the easy access to the needed data (1982 annual reports and 1981-82 pupil achievement data may delay the

finalization of this project); and second, the amount of time it requires to collect and analyze the data are unknown and can only be projected based upon previous experience.

ESTIMATED EXPENDITURES

The following section outlines the expenditures and acquisitions of funds during the course of the project:

Estimated Expenditures

Consultant Services.....	\$4000.00
Personnel Costs	
Student and Graduate Assistants.....	\$3000.00
Travel	
Trips to Richmond for Data Collection.....	\$ 500.00
Miscellaneous	
Materials, Supplies, Xeroxing, etc.....	\$ 500.00
TOTAL EXPENDITURES.....	\$8000.00

Revenue

Funds Obtained through Pilot Study.....	\$4000.00
Funds Obtained through Local Education Agency...	\$4000.00
TOTAL REVENUE.....	\$8000.00

REFERENCES

- Carey, Dennis C. "The Distribution of School Resources and Their Effect Upon Achievement - An Intra-District Approach", ERIC ED151974 EA010477. March, 1978.
- Connors, Eugene T. "An Analysis of Educational Funding in Virginia From 1970 - 1980 and Its Correlation to Pupil Achievement", PILOT STUDY. Virginia State Department of Education, 1981.
- Dawson, D. A. "Economies of Scale and Cost-Quality Relationships in Elementary and Secondary Schools: A Survey." A REPORT BY THE ONTARIO COMMISSION ON DECLINING ENROLLMENTS. Ministry of Government Services; Toronto, Ontario (Canada), March, 1978.
- MOLITOR V. KANELAND COMMUNITY SCHOOL DISTRICT. 18 Ill. 2d 11, 163 n.e. 2d 89 (1959).
- Tallmadge, G. Kasten. "An Analysis of the Relationship Between Reading and Mathematics Achievement Gains and Per-pupil Expenditures in California Title I Projects, Fiscal Year 1972." FINAL REPORT: AMERICAN INSTITUTES FOR RESEARCH IN THE BEHAVIORAL SCIENCES. Palo Alto, Calif., March 1973.
- Webster, Joan M. "A Cost - Effective Analysis of Selected Reading Programs in the Grand Rapids Public Schools", Unpublished Manuscript - ERIC ED063583 CS000012, 1972.